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Finally, 'Tis worth observing, that this Varnish has this known power ; for having spread some of it on the naked Breast of some Fowls, leaving it sticking there for three days, I afterwards found between the dried Varnish and the Flesh the place all festered, and full of a yellowish Serum and Matter, but without any farther mischief to the Body of the Fowls themselves. I have attempted the same thing in Dogs and Cats, but without success, for these Animals with their tongues and claws soon take off all the Varnish from their Bodies, and so have no hurt by it. Possibly in Horses and like Beasts the Experiment may succeed better, if the Varnish has this corrosive or Caustic quality upon their Bodies as it has on Poultry.

IV. Observations upon the Dissolutions and Fermentations which we may call Cold, because they are accompanied with a Coolness of the Liquors into which they pass. And of a new Thermometer. Extracted out of a Discourse, which Mr Geoffroy, F. R. S. made in the Public meeting of the Royal Academy of Sciences, the 21st of April, 1700.

THe different Searches which I have made about the Nature and Propriety of Salts (in order to acquit my self of the Promise I had made of taking some pains in this matter, when I had the Honour to be admitted into this Society) and the different Experiments which I have tryed, in examining their Dissolutions or Mixtures in certain Liquors, have given me occasion to observe, that the Mixture of the greatest part of the Salts in many Liquors is accompanied with a sensible Coldness of the Li-
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quors, notwithstanding the prompt and violent Fermentations which follow many of these Mixtures.

I have distinguish'd these Dissolutions or Mixtures into two Classes. In the former I comprehend all the Simple Cold Dissolutions; that is to say, Those Dissolutions which are not accompanied with any sensible Ferment. The second takes in only the Cold Ferments, or Dissolutions of Salts, which are accompanied with a sensible Ferment, and a Coldness of the Liquor.

CLASS I.

Of Simple Cold Dissolutions.

*Dissolution of
Salts salted in
common water.*

I Put a pint of common Water into a Viol, and an ordinary Thermometer of 18 inches in the Water, and so let it lie some time to fit itself in proportion to the Temperature of the Water. I afterwards put into the Water 4 ounces of *Sal Armoniac*, and the Liquor of the Thermometer descended two inches and 9 lines, in less than a quarter of an hour.

Observing the same Circumstances, I made the same Experiment with Salt-Peter, and the Liquor of the Thermometer descended 1 inch 3 lines.

The same Experiment being made with Vitriol, the Liquor of the Thermometer descended almost an inch.

Sea-Salt made the Liquor descend but 2 lines. And all the Salts being to be put in very lightly, I thought it the hardest matter to pour it in aright.

*Dissolution of
Alkali Volatil
Salted in com-
mon water.*

All the Alkali Volatile Salts cooled the Common Water by their mixture, causing the Liquor of the Thermometer to descend by some Lines: But I observed that they caused it (to do so) more or less, according as they were more or less purified: And the Salt of Urine seem'd to do so soonest of all.

As for the Alkali Lixivious Salts, they were so far from cooling the Water in which they were mingled, that they heated it more or less, according as they were Cal-
Alkalous Lixi-
vious Salts ex-
cepted from the
general Rule,
because that
some of them
do Heat in their
mixture with
water.

Upon the whole, one may observe that the Salts for Heating the Water ought to be purely Alkalous. For if they approach near the nature of Nitre or Sea-Salt, they Heat the Water but a little, or not at all, if they do not rather Cool it. This is also done very considerably by the Salt of Tamarisc, extracted from the *Lixivium* of the Ashes of this Vegetable.

Sal Armoniac mingled with the Acids of Vegetables, as distilled Vinegar, Juice of Limons or Verjuice, gave no mark of a Ferment, but cool'd these Liquors very much.
Salts salted,
mixed with the
Acids of Vege-
tables.

An ounce of *Sal Armoniac* cast into 4 or 5 ounces of Distilled Vinegar causes the Liquor of the Thermometer to descend 2 inches 3 lines.

The same Salt, mixed with the Juice of Limons, caused the Liquor to descend 2 inches. It does the same with Verjuice.

These are the mixtures of Salts with Liquors, which seem'd most remarkable, by reason of the Cold which they excited. Let us now treat of those which are accompanied with Fermentations.

C L A S S II.

Of Cold Fermentations.

Salt-Peter cast into its Acid Spirit raised some Smoke or Vapours, and caused the Liquor of the Thermometer to descend 4 lines.
Salts salted,
mixt with A-
cid Spirits.

Salt-Peter, mixed with Spirit of Vitriol, Smoke exhaled in great quantity, and caused the Liquor to descend from 6 to 7 lines. In these two Experiments I put half an ounce of Salt upon 3 ounces of Liquor.

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I put

I put half an ounce of *Sal Armoniac*, into 3 ounces of Spirit of Nitre, and the Liquor of the Thermometer descended 2 inches 5 lines. This Mixture put forth some Vapours, which seem'd more considerable than those which do ordinarily exhale from Spirit of Nitre alone.

I poured half an ounce of *Sal Armoniac* into 3 ounces of Spirit of Vitriol, which made a violent Fermentation. The Subject Matter was considerably rais'd, and much Vapour went out, the Liquor was very thick, and the Thermometer descended 3 inches 6 lines. I observed, that the Vapours which were rais'd by this Mixture were Hot, and that they considerably rais'd the Liquor of the Thermometer, which I held hanging above the Subject Matter, tho' that which was dip'd within did descend, and shew'd a very great Cold.

*Sea Salt
excepted.*

Sea-Salt mixed with Acid Spirits, Heats the Liquors, instead of Cooling them.

Being mixed with Spirit of Salt, it rais'd the Liquor of the Thermometer some lines, without shewing any sensible Ferment.

With Oil of Vitriol it ferments with a Noise, and raises a great smoke : the Liquor thickens, and becomes a sort of a clear Jelly. The Liquor of the Thermometer rises very much in this Mixture, and the Heat is sensible to the Touch.

*Volatile Alka-
licus Salts
mingled with
Acid Spirits.*

All the Volatile Alkalous Salts mingled with different Acid Liquors, excited a Ferment more or less strong, according to the Acidity of the Liquors, and the Purification of these Salts from their Fetid Oils. They all made the Liquor of the Thermometer to descend : but that which did so the most considerably, is the Salt of Urine.

One ounce of Volatile Salt of Urine very well Rectified, in 4 ounces in Distilled Vinegar, made a strong Fermentation. The substance is elevated very much, and with noise ; and the Liquor of the Thermometer descends in the Ferment one inch 9 lines,

One ounce of Volatile Salt of Urine, in 3 ounces of Spirit of Vitriol, raised a violent Ferment, during which the Liquor of the Thermometer descended 2 inches 4 lines.

The mixture of Salt of Tartar, or other fix'd Alkalous *Fixed Salts* pure Salts, with Acid Liquors excited Fermentations with *purely Acid* Heat. *excepted.*

I made all these Experiments with the same Thermometer, when the Weather was sufficiently Cold, and the Temperature of the Air equal enough.

As to the Reason of these Experiments, I first of all *Reason of the* examined the simple Cold Dissolutions, and having (with *Cold and Dissol-* all Physicians) fixed this Principle, That Cold is nothing *ution of Salts.* but the Diminution of motion; I say, that the Coldness which the Salts bring to the Water, seems to be occasion'd from this, that the Salt Particles being without motion, and dividing that Liquor, diminishes it so much the more. This (is that) which produces the Cold greater or less in the same Liquor.

There is one thing to be observed, which is, that some *Why the Ther-* time after the Dissolution is made, the Liquor of the Ther- *moneter rises a* mometer rises again a little. Which may be occasioned *little, the disso-* by this, that the subtil matter which glided abundantly *lution being* between the Liquid Particles, had ceas'd to glide there in *made.* the same quantity for some time, the gross Particles of the Salts opposing themselves against their Passage; but these Saline Particles being divided by little and little, they opened again the passages to the subtil matter. This gave to the Liquor more Motion than it had at the beginning of the Dissolution; but yet less than it had when it was pure and without mixture; the Saline Particles, altho dissolv'd abating somewhat of their motion.

We may easily comprehend why Lixivious Salts, purely *Whence proceeds* Alkalous and well Calcin'd, as also the Salt of Tartar do *the Heat of the* Heat the Liquor, and are very far from Cooling it, if we *Dissolutions of* consider that these Salts in the strong calcination which *Lixivious Salts* they

they have undergone, are loaded with many Fiery Particles which they hold, as it were in Prison, in their Pores. These Igneous Particles regain their Liberty by the Dissolution of the Saline Particles. And in the same time that these Salts ought to slacken the Motion of the Aqueous Particles, and cool it, the Igneous Particles being very active, do augment the Agitation of the Watry Particles till they make it very hot.

Great Coldness
of *Sal Armoniac*
even to Freezing

I observe next, that *Sal Armoniac* cools the Water wherein it is Dissolved, more than any other Salt. Its Cold equals that of Water which is ready to Freeze. And it happen'd one time, that in Dissolving a good quantity of this Salt in Water, some Drops which fell on the outside of the Viol in which I made the Dissolution did Freeze, and the Straw upon which the Viol stood, being wet, was fastned to the Glass Vessel, for some time, by the Ice. This fell out since the Summer, at a time when the Weather was warm.

I have many times since tryed the same Experiment, in different ways, but without ever being able to produce the Ice. Chance had apparently made me meet in this Experiment, not only a very exact proportion between the Salt and the Water, but also a Temperature in the Water besides, which I suppose necessary: because the Dissolution being quick, the Coldness must also be more sudden and great: and this is that Degree of Temperature to which I could never afterwards attain.

Reason of the
Coldness.

The great Coldness of the Dissolution of *Sal Armoniac* proceeds not from any difficulty which it has to be Dissolv'd, since it dissolves sooner than any other. And Sea-Salt, whose Dissolution is difficult and very slow, is that which does least cool its Dissolver. On the contrary, it seems that the facility and readiness with which it Dissolves, may be the Cause of this great Cold, in this manner.

Sal Armoniac, as every body knows, is a Composition of Sea-Salt and Salt of Urine, the one very easie, the other very

very hard to dissolve ; the Particles of Sea-Salt being, as it were, imprisoned among the Particles of the Salt of Urine, it comes to pass, that many of the Aqueous Particles, penetrating at first dash the Saline Particles of the Urine, do there immediately lose much of their Motion ; and this Motion grows weaker by so much the more, as the Aqueous Particles meet afterwards with Saline Particles of another Nature, whose Resistance is much more considerable, than that of the Salts of Urine. So in the first Instance of the Dissolution, the Motion of a great quantity of Aqueous Particles being very much abated all at once, by the Salts of Urine, and by the Sea Salt, it excited, in a few moments, a Cold far greater than the Cold of other Dissolutions of Salts, which the Water does not penetrate so readily.

It may be Objected, that the Sea-Salt being the hardest to Dissolve, its Dissolution would be also the Coldest. To which I answer, that this might be if the Water could penetrate suddenly into all its parts : but the slowness with which it penetrates them, because of the close Texture of the *Molecules* of this Salt, does hinder that the Diminution of the Motion of the Parts of the Water, can't be so ready, nor by consequence so great : Whereas in *Sal Armoniac*, the Parts of the Sea-Salt being extended by the Salt of Urine, the Pores of the Alkalous Salt of Urine are like so many Ways open to the Parts of the Water, for going to penetrate the Parts of the Sea-Salt in numberless places.

I place in the Rank of Cold Dissolutions, an Experiment which Monsieur *Homborg* made some time ago, before the Society, and which I believe will not be amiss if I should repeat it here ; because it serves to prove that which I am going to say about the Cold of *Sal Armoniac* ; the Experiment being otherwise not very common. 'Tis made thus : Take a pound of Corrosive Sublimate, and a pound of *Sal Armoniac*, powder them, each apart ; then mix both the Powders very exactly, put the Mixture into

Experiment of a Saline Dissolution on extremely cold.

a Viol, pouring upon it a Pint and half of Distilled Vinegar, shaking it well together. This Composition will be so very Cold, that a man can hardly hold the Vessel in his hands in Summer. And it chanced that as Monsieur *Homburg* was making this mixture, that the Subject froze.

We see in this Experiment a Cold yet greater than that in the Dissolution of *Sal Armoniac* alone in Common Water. And this Cold is caused by the Corrosive Sublimate, which alone is not at all, or at least very little Dissoluble in Distilled Vinegar. So that the fluid parts of the distilled Vinegar having quickly penetrated the Parts of the *Sal Armoniac*, and having already lost a great deal of their Motion, engaging afterwards in the Pores of a Body which they could not Dissolve, and having Action not more than enough for that, they do there lose that little Activity which they had. They coagulate there, if not at all, at least the greatest part: and this want of Action is the cause of that great Cold which we perceive there.

Till now, I have only considered Simple cold Dissolutions of Salts, in which there is no Augmentation of a sensible Motion; Let us now pass to the Dissolutions of the second Class, which are the cold Ferments, in which the Cold appears as a Consequence of the Agitation of the parts of the Liquor.

*Explications of
Cold Ferments.*

In order to shew the Reason of Cold Ferments, I own (with the Physicians) that Heat and Cold in Liquors are neither more nor less than Motion in the little parts of these Liquors, caused by the continual current of the Subtil Matter in the Spaces which these Particles do leave between them. And I affirm, that every time this Motion is diminished, and when the Course of the Subtle Matter is interrupted, the Liquor appears less Hot or more Cold.

This being supposed, if we do attend to that which happens in Cold Fermentations, we shall observe on the one hand for the most part, very considerable Coagulations, and a very sensible Thickening of the Liquors: on the

the other hand, we shall perceive a very violent agitation of some of the parts of these mixtures : Many Vapours are exhaled, the matter swells, sends out many Bubbles and Ferments with Noise. And in this manner I conceive that all these effects are produced.

In the mixture which I made of Salts with Acid Liquors, the greatest part of the Liquor coagulating with a part of the Salts, its motion was much abated in a little time ; but its parts not being able to coagulate, without stopping or weakning the current of the subtil matter ; this matter finding the passages shut up, takes its course by the Interstices, which remained between the Coagulated Particles, where the passage was yet free ; and as if glided away in a quantity together, it caused a very considerable Agitation in the parts which it met with in its passage. 'Tis this agitation which causes the Fermentation which we perceive : 'Tis this which raises the Bubbles of Air and the Smoke : 'Tis this which puffs up and swells the matter with so much the more Violence, as all the parts of the Liquor being almost half coagulated, do hinder the Motion and Agitation of these little Particles. Nevertheless this Agitation, how violent soever it may appear, is not considerable enough to break the Coagulum intirely, which is formed in the Liquor, nor consequently to overcome the Cold, which causes this Coagulation. All it can do, is to preserve yet some kind of Fluidity. In short, the more these mixtures are dispos'd to coagulate, the more they excite the cold. This we may see in the mixture of Sal Armoniac with Oil of Vitriol, in which the Coagulum becomes so strong, that at last, it forms above the Liquor a very thick Saline Crust. In the mixture of other Salts with weaker Acids, as in the mixture of Volatil Salts with Spirit of Vinegar, the Coagulum can hardly be perceived ; nor is the Cold so considerable as in the former.

I add farther, that even the violent Agitation which this mixture causes, being not universal, and passing no farther than some few places of the Liquor ; it may for all that, contribute to the great Coldness in the mixture of Sal Armoniac and Oil of Vitriol in encreasing the Coagulum, so that the little Particles which are violently agitated in this Mixture, being not able to draw along with them in their motion the Coagulated parts which are too gross ; they drive them away from the Center of their Motion : So that these particles almost half coagulated, being got amongst these little Whirl-pools, and press'd one against another, they stick close to one another, coagulate still more strongly, and lose their motion entirely ; which causes a very great cold. If any man can scarce persuade himself that the Violent Agitation in some parts of the Mixture does contribute to the Coldness of the Liquor, he may be convinced by the following Experiment.

*Experiment of
Water cooled by
Fire.*

I put some cold Water into a great Basin, I put into the middle of the Water a Cucurbit of Glass full of Water equally cold. I put into the Cucurbit a very good Thermometer, which I let lie a good while for a Tryal.

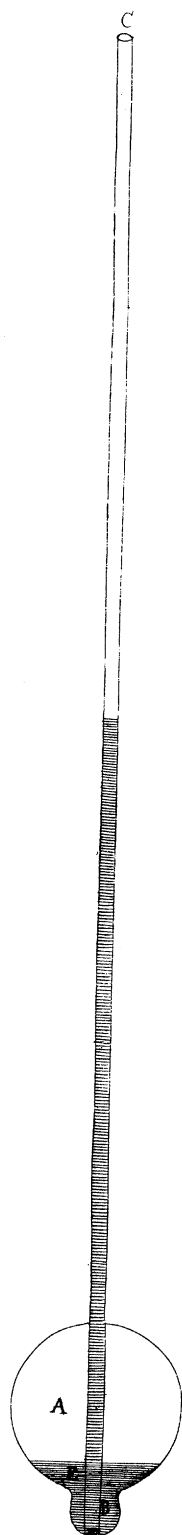
When it was adjusted to a Degree proportionable to the Cold of the Water, I threw suddenly into the Water in the Basin four or five Shovels full of Coals well kindled ; and in an instant, the Liquor of the Thermometer descended 2 or 3 lines. After some moments, the Liquor rose again, when the Heat of the Water in the Basin was communicated to the Vessel of Glass.

*Reason of this
Experiment.*

The Cold of the Water of the Cucurbit, can't be attributed to any thing besides the Pressure or sudden Condensation which the Fire caused in the Water, wherein it was put. Which condensation may be explained in this manner.

In the instant that the burning Coals were thrown into the Water, the Vortex of the Subtil Matter by which it was turn'd round, being press'd by the Water which environed it, scatter'd with violence all the particles of the
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Water. This scattering being made all at a time in many Places of the Water in the Basin all round the Vessel of Glass: All the Particles which environ'd the Vessel being at once press'd on all sides were condensed considerably and successively. The Vessel being in the Center of Pressure bore all the weight of this pressure, as well as the Liquor which contained it. And this Liquor lost by its Condensation very much of the motion of the Liquid, which it had before, which was considerable enough to cause the Liquor of the Thermometer to fall. This Cold goes off quickly, because all the Water in the Basin being very much heated, it quickly heats also that in the Vessel of Glass.

The ordinary Thermometers not being capable of marking to me the Cold of the Water so readily and nicely as I would, in this Experiment, I had recourse to another sort of Thermometer which was more exact. This Thermometer is made of a Bowl of Glass, A, which has no other opening than that of a very long Tunnel, BC, which descends almost to the bottom of the Bowl. One end of the Tunnel is dipp'd in a Liquor E which is at the bottom of this Bowl, and the rest is fill'd with nothing but Air. When the Air rarefies, it compresses the Liquor which it forces to rise in the little Tunnel. And when it condenses it gives the Liquor liberty to fall. This Thermometer is more sensible than any other, because the Air which is its Mover, does rarefie with Heat, and condenses with Cold, sooner than any Liquid.

As for the sensible Heat of the Vapours which rise from the Mixture of *Sal Armoniac* with Oil of Vitriol; it is not difficult to find the Cause, if we consider that these Vapours are but the most subtil and active parts of this Mixture, which the subtil Matter raises with in it crossing it. The Motion of these Particles is free in the Air; it is but more repressed by the too gross coagulated Particles. It becomes by so much the more violent, by how much it has been retain'd and Hindred for some time; and is perceived by Heat, which is the ordinary Effect of rapid and violent motion.

*Reasons of the
Hot Vapours
from the Cold
Ferment caus'd
by the mixture
of Sal Armoniac
and Oil of
Vitriol.*

I will

*Change of the
Cold Ferment
from the mix-
ture of Sal Ar-
moniac and Oil
of Vitriol, into
a very hot
Ferment with a
little Water.*

I will relate another considerable Experiment of the Cold Fermentation caused by the Mixture of *Sal Armoniac* and Oil of Vitriol.

If after having made the Mixture of 4 ounces of Oil of Vitriol, and an ounce of *Sal Armoniac*, one throws upon it a spoonful of common Water, in the time when the Fermentation is strongest, the Cold is greatest, and the Thermometer falls with the greatest quickness, the Ferment ceases, and the Cold changes immediately into a great Heat, and makes the Liquor of the Thermometer to rise very high.

One may easily conceive the Reason of this Experiment, if we consider that the Water heating quickly and strongly with the Oil of Vitriol, makes here the same Effect. And this Heat is sufficiently great, at that time to destroy the Cold of the coagulated Particles, the Water by it self being otherwise very proper to dissolve this *Coagulum*.

It remains, that I give an account why Sea-Salt heats with different Acid Liquors: but as to that, we ought to enquire into the Nature of this Salt, which would carry us too far.

I will only say before I make an end, that I do not here pretend to enumerate exactly all the Cold Dissolutions and Fermentations; I have related only the Experiments which I have made upon the Salts and Liquors which we ofteneft use, and which I thought most considerable. As to the Reasons which I have given of these Cold Dissolutions and Fermentations; I advance them only as Conjectures, which I submit to the Judgment of Physicians, who understand these matters better than I do.

The New Thermometer, whose Effects is more quick than that of Ordinary Thermometers.

IT is composed of a Bowl or Bottle of Glass, which has no opening, but by a little Tunnel at the end; and which descends to the bottom. This Tunnel is open at both ends B C. B dips into the Liquor E which is at the bottom of the Bowl.

The space of the Bottle of Glass is fill'd with Air, which has no Communication with the Exterior Air.

When the Air contain'd in this Space is rarefied by the exterior Air which touches the Bottle, it presses at the same time the Liquor E, and obliges it to rise by B in the Tunnel B C. On the contrary, when it Condenseth by the Exterior Cold, by not pressing the Liquor E, it permits that which is in the Tunnel to Fall.

The Readiness with which the Air Condenses or Rarefies by Cold and to Heat, makes the Effects of this Thermometer much more sudden than those of any other sort. Besides, the Effects of this is much greater, the Air being more capable of a great Rarefaction, or of a great Condensation, than any other Liquor.